

## CLAIMS

What is claimed is:

- 5           1.       A method for enhancing transmitted audio data, comprising:  
            coding audio data into a digitally formatted signal;  
            enhancing the digitally formatted signal by pre-emphasizing frequencies  
            and dynamics expected to be lost or distorted, resulting in an enhanced audio  
            signal;  
10           transmitting the enhanced audio signal to a client site;  
            decoding data contained in the enhanced audio signal after transmission to  
            the client site, resulting in a decoded audio signal; and  
            processing the decoded audio signal to recover frequencies and dynamics  
            preserved by pre-emphasis of the frequencies and dynamics expected to be lost or  
15           distorted.
2.       The method of claim 1, wherein the frequencies and dynamics  
            expected to be lost or distorted are attributable at least in part to compression of  
            the audio signal.  
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3.       The method of claim 1, wherein the frequencies and dynamics  
            expected to be lost or distorted are attributable at least in part to transmission of  
            the audio signal.
- 25           4.       The method of claim 1, further comprising compressing the  
            enhanced audio signal prior to its transmission, resulting in a compressed  
            enhanced audio signal.
5.       The method of claim 4, further comprising decompressing the  
30           compressed enhanced audio signal subsequent to its transmission.

6. A method for enhancing audio signals, comprising:  
receiving an audio signal;  
separating the audio signal into component signals corresponding to discrete bands;  
5 processing one or more of the component signals with distinct processing pathways, resulting in processed component signals;  
aggregating the processed component signals to recreate a standard signal in one or more channels; and  
performing additional post-processing on the standard signal to mask  
10 artifacts and response anomalies introduced by a codec and equipment used, resulting in an enhanced audio signal.

7. A method according to claim 6, wherein the audio signal is a compressed audio signal.

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8. A method according to claim 6, wherein the separating step separates the audio signal into at least one full bandwidth component signal and at least one limited bandwidth component signal.

20 9. A method according to claim 8, wherein the at least one limited bandwidth component signal comprises at least one of: a bass component signal, a midrange component signal, and a treble component signal.

25 10. A method according to claim 6, wherein the post-processing comprises at least one of:

3D/live enhancement for adding life and stereo perspective to the sound field of the enhanced audio signal;

recording environment simulation for adding diffusion, reverb, depth, regeneration, and room decay to the enhanced audio signal;

30 voice elimination for reducing vocals in the enhanced audio signal;

wide stereo enhancement for adding wider stereo perspective to the sound field of the enhanced audio signal;

parametric equalization for providing broad spectrum shaping of the enhanced audio signal;

filtering the enhanced audio signal to reinforce subwoofer and bass frequencies;

wall simulation for producing time delays that simulate reflections from a stage;

5 room simulation for producing time delays that simulate natural room acoustics;

karaoke enhancement for removing equal energy components from left and right signal channels;

vocal enhancement for clarifying vocal features;

10 subsonic enhancement for low-bass reinforcement of the enhanced audio signal; and

look-ahead automatic gain control for controlling output dynamic range.

11. A method according to claim 6, wherein the post-processing  
15 includes room simulation for compensating for poor room acoustics in a listening environment for the enhanced audio signal.

12. A method for compensating for audio equipment operated in a poor acoustic environment, comprising:

20 obtaining a measured impulse response of a listening environment in which audio equipment is present;

deriving a compensatory process using the measured impulse response; and

25 compensating for flaws in the listening environment and audio equipment during audio playback by employing the compensatory process.

13. A method according to claim 12, wherein the obtaining step measures the impulse response with a microphone located within the listening environment.

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14. A method according to claim 12, wherein the obtaining step comprises:

producing sound, using the audio equipment, having a known frequency spectrum;

transducing a test signal generated in response to the sound, the test signal indicating acoustics of the listening environment; and

calculating a room transform function based upon the spectrum of the test signal and the known frequency spectrum of the sound.

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15. A system for enhancing audio signals, comprising:

a full bandwidth pathway for processing a full bandwidth component of an audio signal, the full bandwidth pathway producing a processed full bandwidth signal;

10 at least one limited bandwidth pathway for processing a limited bandwidth component of the audio signal, the limited bandwidth pathway producing a processed limited bandwidth signal;

a mixer configured to combine the processed full bandwidth signal and the processed limited bandwidth signal to create a mixed audio signal; and

15 one or more post-processing elements for further enhancement of the mixed audio signal.

16. A system according to claim 15, wherein the at least one limited bandwidth pathway comprises at least one of:

20 a bass pathway for processing a bass component of the audio signal;

a midrange pathway for processing a midrange component of the audio signal; and

a treble pathway for processing a treble component of the audio signal.

25 17. A system according to claim 15, wherein the one or more post-processing elements comprises at least one of:

a 3D/live enhancement element configured to add life and stereo perspective to the sound field of the mixed audio signal;

30 a recording environment simulator configured to add diffusion, reverb, depth, regeneration, and room decay to the mixed audio signal;

a voice elimination element configured to reduce vocals in the mixed audio signal;

a wide stereo enhancement element configured to add wider stereo perspective to the sound field of the mixed audio signal;

a parametric equalizer configured to provide broad spectrum shaping of the mixed audio signal;

at least one filter configured to reinforce subwoofer and bass frequencies in the mixed audio signal;

5 a wall simulator configured to produce time delays that simulate reflections from a stage;

a room simulator configured to produce time delays that simulate natural room acoustics;

10 a karaoke enhancement element configured to remove equal energy components from left and right signal channels;

a vocal enhancement element configured to clarify vocal features;

a subsonic enhancement element configured to reinforce low-bass components of the enhanced audio signal; and

15 a look-ahead automatic gain control element configured to control output dynamic range.

18. An apparatus for playback of digital audio files, said apparatus comprising:

a digital audio signal source;

20 at least one processor coupled to the digital audio signal source, said at least one processor being configured to carry out a method comprising:

receiving an audio signal from the digital audio signal source;

separating the audio signal into component signals corresponding to discrete bands;

25 processing one or more of the component signals with distinct processing pathways, resulting in processed component signals;

aggregating the processed component signals to recreate a standard signal in one or more channels; and

30 performing additional post-processing on the standard signal to mask artifacts and response anomalies introduced by a codec and equipment used, resulting in an enhanced audio signal; and

one or more speaker drivers coupled to the processor, the one or more speaker drivers being configured to drive one or more speakers for playback of the enhanced audio signal.

19. A method for enhancing delivery of audio signals, the method comprising:

modifying an audio signal by creating a time beat among sound streams in  
5 the audio signal, resulting in a modified audio signal; and  
inserting reflection components into the modified audio signal.

20. A method according to claim 19, wherein the modifying step includes the steps of:

10 forming at least a first sound stream and a second sound stream for the audio signal; and

altering the characteristics of the audio signal in the second sound stream while maintaining an alignment in time between signals in the first sound stream and the second sound stream.

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21. A method according to claim 20, wherein:

the forming step includes the step of compressing the audio signal in the first sound stream in accordance with a first set of parameters; and

the altering step includes the steps of:

20 filtering the audio signal in the second sound stream to obtain a filtered audio signal; and

compressing the filtered audio signal according to a second set of parameters different from the first set of parameters.

25 22. A method according to claim 21, further including the step of selecting the second set of parameters to provide an altered audio signal from the second sound stream which has the characteristics of sounds emanating from a selected environment.

30 23. A method according to claim 19, wherein the inserting step includes inserting at least one of early, mid, and late reflection components.

24. A method according to claim 19, wherein the modifying step includes the steps of:

forming a full range sound stream, a low range sound stream, a mid range sound stream, and a high range sound stream;

low-pass filtering the audio signal in the low range sound stream to obtain a low-pass filtered audio signal;

5 compressing the low-pass filtered audio signal according to a “dead” environment set of parameters;

band-pass filtering the audio signal in the mid range sound stream to obtain a band-pass filtered audio signal;

10 compressing the band-pass filtered audio signal according to a “scoring” stage environment set of parameters;

high-pass filtering the audio signal in the high range sound stream to obtain a high-pass filtered audio signal;

compressing the high-pass filtered audio signal according to a “plaster wall” environment set of parameters.

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25. A method of enhancing delivery of audio signals to a listener, the method comprising:

modifying an audio signal by creating a difference in the dynamics of sound streams in the audio signal, resulting in a modified audio signal;

20 adding predictable environmental characteristics to the modified audio signal to form an enhanced audio signal; and

delivering the enhanced audio signal to the listener.

26. A method according to claim 25, further including the step of  
25 inserting sound field enhancing features into the enhanced audio signal to provide alternative listening sound field controllability to the listener.

27. A system for enhancing audio signals, comprising:

30 a full bandwidth pathway for processing a full bandwidth component of an audio signal, the full bandwidth pathway producing a processed full bandwidth signal, the full bandwidth pathway comprising:

a first input amplifier having an input for the audio signal, a first output amplifier having an output for the processed full bandwidth signal, and a

first compressor connected between the first input amplifier and the first output amplifier;

at least one limited bandwidth pathway for processing a limited bandwidth component of the audio signal, the limited bandwidth pathway producing a processed limited bandwidth signal, the at least one limited bandwidth pathway comprising:

a second input amplifier having an input for the audio signal, a second output amplifier having an output for the processed limited bandwidth signal, a second compressor connected between the second input amplifier and the second output amplifier, and a filter connected between the second input amplifier and the second output amplifier; and

a mixer configured to combine the processed full bandwidth signal and the processed limited bandwidth signal to create a mixed audio signal.

28. A system according to claim 27, further comprising one or more post-processing elements for further enhancement of the mixed audio signal.

29. A system according to claim 27, wherein at least one of the first input amplifier, the first output amplifier, the second input amplifier, and the second output amplifier is a variable gain amplifier.

30. A system according to claim 27, wherein the at least one limited bandwidth pathway comprises at least one of:

a bass pathway for processing a bass component of the audio signal;  
a midrange pathway for processing a midrange component of the audio signal; and  
a treble pathway for processing a treble component of the audio signal.

31. A system according to claim 30, wherein:  
for the bass pathway, the filter is a low-pass filter;  
for the midrange pathway, the filter is a band-pass filter; and  
for the treble pathway, the filter is a high-pass filter.



32. A system according to claim 27, further comprising a pre-compressor configured to receive an input audio signal and to generate the audio signal as a compressed representation of the input audio signal.

5 33. An apparatus for playback of digital audio files, said apparatus comprising:

a digital audio signal source;

at least one processor coupled to the digital audio signal source, said at least one processor being configured to carry out a method comprising:

10 modifying an audio signal by creating a time beat among sound streams in the audio signal, resulting in a modified audio signal; and

inserting reflection components into the modified audio signal; and

one or more speaker drivers coupled to the processor, the one or more speaker drivers being configured to drive one or more speakers for playback of the  
15 enhanced audio signal.

34. An apparatus for playback of digital audio files, said apparatus comprising:

a digital audio signal source;

20 at least one processor coupled to the digital audio signal source, said at least one processor being configured to carry out a method comprising:

modifying an audio signal by creating a difference in the dynamics of sound streams in the audio signal, resulting in a modified audio signal;

25 adding predictable environmental characteristics to the modified audio signal to form an enhanced audio signal; and

inserting sound field enhancing features into the enhanced audio signal to provide alternative listening sound field controllability to the listener; and

30 one or more speaker drivers coupled to the processor, the one or more speaker drivers being configured to drive one or more speakers for delivery of the enhanced audio signal to the listener.